hydride and olefine containing an equal number of carbon atoms as in the above equation. Neither supposition is exactly substantiated by experiment. If the action of heat gave rise to the former mode of decomposition, we ought to obtain a larger quantity of ethylene after prolonged heating, especially when the liquefied portion is rich in hydrocarbons of low molecular weight; but it has already been pointed out that the process of liquefaction is accompanied with the production of comparatively little gas. On the other hand, an examination of the amounts of bromine required to render the hydrocarbons boiling above 200° permanently red, shows that the proportion of hydride to olefine in the several mixtures becomes gradually larger as the molecular weight increases.

It would doubtless have been interesting to have determined the relative amounts of the twelve fractions isolated from the decomposed paraffin; but when it is considered that their separation was only effected after several thousand distillations, it will be evident that the quantities obtained after such prolonged treatment can afford no real indication of the amounts present in the original liquid. It appears, however, that the amounts of liquid boiling at 94–97° and 122–125° were but slightly, if at all, less than the quantities boiling at 252–255° and 273–276°.

XIX. "On the Echinidea of the 'Porcupine' Deep-sea Dredging-Expeditions." By Prof. Wyville Thomson, LL.D., D.Sc., F.R.S. Received June 15, 1872.

(Abstract.)

The deep-sea dredging-cruises of H.M. Ships 'Lightning' and 'Porcupine' during the summers of 1868, 1869, and 1870 in the North Atlantic, were comprehended within a belt 1500 miles in length by from 100 to 150 miles in width, extending from the Færöe Islands along the northern and western coasts of Scotland and Ireland and the coasts of Portugal and Spain to the Strait of Gibraltar. In this area fifty-seven successful hauls of the dredge were made during the three summers in water exceeding 500 fathoms in depth, sixteen beyond 1000 fathoms, and two beyond 2000 fathoms.

Even at the latter extreme depth Echinodermata appeared to be abundant. At 2435 and at 2090 fathoms all the Echinoderm orders were represented—the Echinidea by a small variety of *Echinus norvegicus*, D. & K., and a young example of *Brissopsis lyrifera*, Forbes; the Asteridea by a species of the genus *Archaster*; the Ophiuridea by *Ophiocten sericeum*, Forbes, and *Ophiacantha spinulosa*, M. & T.; the Holothuridea by *Echinocucumis typica*, Sars; and the Crinoidea by a very remarkable new form of the Apiocrinidæ, which has been described under the name of *Bathycrinus gracilis*, Wy. T. From 2000 fathoms upwards the number of Echinoderms seems to increase rapidly; but this apparent increase may possibly be

The Royal Society is collaborating with JSTOR to digitize, preserve, and extend access to *Proceedings of the Royal Society of London.* www.jstor.org

due to our wider knowledge of the fauna of the shallower water; from 300 to 800 fathoms along the coast of Britain many species of all the orders are enormously abundant, so much so as to give a very marked character to the fauna of that special zone. Several of these species, such as *Cidaris papillata*, Leske, *Toxopneustes drobachiensis*, Müller, *Echinus norvegicus*, D. & K., *Astropecten tenuispinus*, D. & K., *Archaster Parellii*, D. & K., *A. Andromeda*, M. & T., and *Euryale Linkii*, M. & T., have been long known to inhabit the deep water of the British area, and form part of a fauna which will be probably found to have a very wide lateral extension at temperatures whose minimum ranges from 0° C. to +2° C., a fauna which crops up, as it were, within the ordinary limits of observation in the seas of Scandinavia, and which has consequently been carefully studied by the Scandinavian naturalists.

Another group of species, including *Tripylus fragilis*, D. & K., *Ctenodiscus crispatus*, Retzius, *Pteraster militaris*, M. & T., *Amphiura abyssicola*, Sars, *Antedon Eschrichtii*, O. F. Müller, and several others, are members of the same fauna described from localities in the seas of Scandinavia and Greenland, but not hitherto known as British. A third section, consisting of a number of undescribed Echinideans, Asterideans, and Ophiurideans, may probably also belong to this fauna; while a fourth group, likewise undescribed, and including such forms as *Porocidaris*, *Phormosoma*, *Calveria*, *Pourtalesia*, *Neolampas*, *Zoroaster*, *Ophiomusium*, *Pentacrinus*, *Rhizocrinus*, and *Bathycrinus*, would rather appear to be referable to a special deep-sea fauna of which we as yet know only a few examples, and with whose conditions and extension we are unacquainted. This abyssal fauna is of great interest, inasmuch as nearly all the hitherto discovered forms referred to it show close relations to family types of Cretaceous or early Tertiary age, and hitherto supposed to be extinct.

Twenty-seven species of Echinidea were procured during the cruises of 1868, 1869, and 1870, off the coasts of Britain and Portugal, at depths varying from 100 to 2435 fathoms.

Cidaridæ.

Cidaris, Lamarck.

1. *C. papillata*, Leske.

Occurs in enormous numbers on gravel at depths from 100 to 400 fathoms, from Færöe to Gibraltar, and small-sized examples are frequent down to 1000 fathoms. This is a variable species, and every possible link may be shown between the typical *C. papillata*, Leske, and *C. hystrix*, Lam. I have no hesitation, after examining many hundreds of specimens, in fusing the two forms into one species.

2. *C. affinis*, Stokes.

This is a pretty little species, and apparently distinct, although it is sometimes not easy to draw the line between it and small forms of *C. papillata*.

It occurs abundantly in the Mediterranean, and locally off the coast of Portugal.

Porocidaris, Desor.

This genus was established by Desor chiefly on a character which I cannot regard as of great importance, and which is absent in the present species, a row of small holes surrounding the tubercles of the primary spines in the scrobicular areæ. From the description these holes seem to be nothing more than complete perforations, owing to imperfect calcification, in the position of the depressions which frequently occur in the scrobiculæ of the Cidaridæ for the insertion of the muscles of the spines. Along with this character, however, there were some others of greater value, a very remarkable paddle-like form of the spines surrounding the mouth, and a tendency to coalescence in the scrobicular areæ. These characters are well marked in the species described. This genus has hitherto only been found fossil—a few detached plates and some of the characteristic spines in the Nummulitic beds of Verona and Biarritz, and some spines referred to the genus, on account of their having the same singular form, in the Lower Oolite of Frick.

1. *P. purpurata*, n. sp.

Four examples from depths from 500 to 600 fathoms off the Butt of the Lews.

ECHINOTHURIDÆ.

I think it due to the memory of the late Dr. S. P. Woodward to adopt as the type of this very distinct and remarkable family the genus *Echinothuria*, which he described with singular sagacity from one or two imperfect specimens from the White Chalk. The Echinothuridæ are regular urchins with depressed tests, rendered perfectly flexible by the whole of the plates, both ambulacral and interambulacral, being arranged in imbricating rows, the interambulacral plates overlapping one another from the apex to the mouth, and the ambulacral plates in the opposite direction. The margin of the peristome is entire, and the peristomial membrane is covered with imbricated scales, through which the ranges of double pores and ambulacral tubes are continued up to the edge of the mouth as in *Cidaris*. The ambulacral plates are strap-shaped, and the pores trigeminal; the two inner pairs of each arc pass through small accessory plates intercalated between the ambulacral plates, and the third pair, remote from the others, pass through the end of the ambulacral plate. The dental pyramid is broad and low, and the teeth are simply grooved as in *Cidaris*. The two divisions of the tooth-socket are not united by a closed arch; the ambulacral tube-feet on the oral surface are provided with suckers, while those on the apical surface are simple and conical.

Phormosoma, n. g.

Plates overlapping slightly and forming a continuous shell, the corona coming to a sharp edge at the periphery, and the upper surface of body differing greatly in character from the lower.

1. *P. placenta*, n. sp.

One example from 500 fathoms off the Butt of the Lews; several fragments from deep water in the Rockall Channel.

Calveria, n. g.

Plates overlapping greatly in the middle line of the ambulacral and interambulacral areæ. Plates narrow, and leaving fenestræ between them which are filled up with membrane. Character of the peristome with regard to the distribution of spines, the structure of the pore-areæ, &c. nearly uniform from the apex to the edge of the peristome.

1. *C. hystrix*, n. sp.

Fenestræ between the plates small. Colour a nearly uniform rich claret. One specimen in deep water off the Butt of the Lews.

2. *C. fenestrata*, n. sp.

Plates narrower than in the last species, and fenestræ wider. Of a pale grey colour, with bands of chocolate radiating from the apical pole. Two specimens from the coast of Portugal, and fragments in deep water off the south and west of Ireland.

ECHINIDÆ.

Echinus, Link.

1. *E. melo*, Lam.

One or two small specimens off the coast of Portugal.

2. *E. Flemingii*, Ball.

The large typical form of this species was met with in deep water off the Shetlands, but not abundantly.

3. *E. rarispina*, G. O. Sars.

4. *E. elegans*, D. & K.

5. *E. norvegicus*, D. & K.

The last three are critical species; and although the extreme forms are very dissimilar, in a large series there are so many intermediate links, that it is difficult to tell where the one begins and the other ends. It is possible that they ought to be regarded as varieties, and lumped together under Lamarck's name, *E. acutus*.

6. *E. microstoma*, n. sp.

Although I have great hesitation at present in proposing an addition to the genus *Echinus*, I feel compelled in the meantime to separate this very distinct form with a thin depressed test, a remarkably large periproct, and a small peristome with the edge markedly curved inwards and a uniform vivid red colour. *E. microstoma* is very abundant from 150 to 400 fathoms off the west coasts of Scotland and Ireland.

Sphærechinus, Desor.

1. *S. esculentus*, L., sp.

A marked variety, with a tall narrow test and white spines, in deep water,

Toxopneustes, Agassiz.

1. *T. drobachiensis*, Müller.

Of this species it seems to me that *T. pictus*, Norman, and *T. pallidus*, G. O. Sars, can only be regarded as varieties. It is generally distributed at depths beyond 100 fathoms.

2. *T. brevispinosus*, Risso, sp.

Shallow water on the coast of Spain.

Psammechinus, Agassiz.

1. *P. miliaris*, Lam., sp.
2. *P. microtuberculatus*, Ag.

CASSIDULIDÆ.

Neolampas, A. Agassiz.

This genus, with a nearly central pentagonal mouth and a tolerably distinct floscelle, with the anal opening at the bottom of a deep posterior groove excavated in a kind of projecting rostellum, with narrow ambulacral areæ and a small compact group of apical plates, must be referred to the Cassidulidæ; but it differs from all known genera of the family, living or extinct, in having no trace of a petaloid arrangement of the ambulacra, which are reduced on the apical surface of the test to a single pore penetrating each ambulacral plate, and thus forming a double row of alternating simple pores for each ambulacral area.

1. *N. rostellatus*, A. Ag.

I believe I am correct in referring to this species a single specimen dredged at the mouth of the English Channel. It is upwards of an inch in length, and therefore nearly double the size of the examples procured by Count Pourtales in depths from 100 to 150 fathoms in the Strait of Florida.

CLYPEASTRIDÆ.

Echinocyamus, Van Phelsum.

1. *E. angulatus*, Leske.

Generally distributed, but not found living beyond 150 fathoms.

ANANCHYTIDÆ.

Pourtalesia, A. Agassiz.

According to the classification of Desor, which makes the "disjunct" arrangement of the ambulacra at the apex the test character of the Dysasteridæ, this genus should be referred to that group; for the apical disk is truly decomposed as in *Dysaster* and *Collyrites*, and not merely drawn out as in *Ananchytes*. From the arrangement and form of the pore-plates, however, and from the general appearance and habit of the animal, I am inclined to think with A. Agassiz that its affinities are more with such forms as *Infulaster*. *Pourtalesia* must be an aberrant form, in whatever

group it may be placed. The mouth is at the bottom of a deep anterior groove, occupying the anterior ambulacral area. The arrangement of the trivium is nearly normal; but the bivial region is enormously prolonged backward into a long rostrum, on the upper surface of which, near its posterior extremity, the anus is situated in a pit partially covered by a projecting boss. The ambulacral pores are simple, one pore on each plate.

1. *P. Jeffreysi*, n. sp.

A single specimen of this very remarkable form was dredged in 640 fathoms to the north of the Shetlands. It is nearly allied to *P. miranda*, Pourtales, from the Strait of Florida, but differs in several details.

2. *P. phyale*, n. sp.

Two or three small specimens were dredged by Mr. Gwyn Jeffreys in the Rockall Channel. All the specimens are immature; but from the marked difference in form, and from some other characters, I believe them to be the young of a second species.

Spatangidæ.

Brissopsis, Agassiz.

1. *B. lyrifera*, Forbes, sp.

Large specimens of this species are abundant from 50 to 250 fathoms. Beyond the latter depth the specimens decrease in size, and at extreme depths only examples which have all the appearance of being very young are met with. These small delicate specimens were found at all depths, even down to 2090 fathoms.

Tripylus, Philippi.

1. *T. fragilis*, D. & K.

From 400 to 500 fathoms between Scotland and Færöe. Hitherto known as Scandinavian.

Schizaster, Agassiz.

1. *S. canaliferus*, Val.

A single small specimen from the coast of Spain.

Amphidetus, Agassiz.

1. *A. ovatus*, Leske, sp.

Abundant at moderate depths.

Spatangus.

1. *S. purpureus*, O. F. Müller.

2. *S. Raschi*, Lovén.

This species is apparently gregarious, and is enormously abundant in patches here and there from the Færöes to the Strait of Gibraltar at depths from 100 to 300 fathoms.

Of the twenty-seven species observed, six (namely *Echinus Flemingii*, *Sphærechinus esculentus*, *Psammechinus miliaris*, *Echinocyamus angulatus*, *Amphidetus ovatus*, and *Spatangus purpureus*) may be regarded as denizens

of moderate depths in the "Celtic province," recent observations having merely shown that they have a somewhat greater range in depth than was previously supposed. Probably *Spatangus Raschi* may simply be an essentially deep-water form having its headquarters in the same region. Eight species (*Cidaris papillata, Echinus elegans, E. norvegicus, E. rarispina, E. microstoma, Toxopneustes dröbachiensis, Brissopsis lyrifera,* and *Tripylus fragilis*) are members of a fauna of intermediate depth; and all, with the doubtful exception of *Echinus microstoma*, have been observed in comparatively shallow water off the coasts of Scandinavia. Five species (*Cidaris affinis, Echinus melo, Toxopneustes brevispinosus, Psammechinus microtuberculatus,* and *Schizaster canaliferus*) are recognized members of the Lusitanian and Mediterranean faunæ, and seven (*Porocidaris purpurata, Phormosoma placenta, Calveria hystrix, C. fenestrata, Neolampas rostellatus, Pourtalesia Jeffreysi,* and *P. phyale*) are forms which have for the first time been brought to light during the late deep-sea dredging operations, whether on this or on the other side of the Atlantic: there seems little doubt that these must be referred to the abyssal fauna, upon whose confines we are now only beginning to encroach. Three of the most remarkable generic forms, *Calveria, Neolampas,* and *Pourtalesia,* have been found by Alexander Agassiz among the results of the deep-dredging operations of Count Pourtales in the Strait of Florida, showing a wide lateral distribution; while even a deeper interest attaches to the fact that while one family type, the Echinothuridæ, has been hitherto known only in a fossil state, the entire group find nearer allies in the extinct faunas of the Chalk or of the earlier Tertiaries than in that of the present period.

XX. "On Supersaturated Saline Solutions." By Archibald Liversidge, Assoc. R.S. Mines, and Scholar of Christ's College, Cambridge. Communicated by Prof. W. H. Miller, For. Sec. R.S. Received June 13, 1872.

There is, perhaps, no necessity to describe in detail the ordinary phenomena presented by supersaturated saline solutions, since they must now be well known to all.

The following series of experiments have chiefly been made upon sodic sulphate; but before citing them, it may, however, not be out of place to briefly allude, *en passant,* to the conclusions drawn by the numerous writers and experimenters upon this subject, since the results of my own experiments are supported by the authority of some of these observers and run counter to that of others.

The theories which have been put forth are, in the main, as follows:—

a. That the crystallization of supersaturated solutions is caused by purely mechanical agencies, such as agitation &c. The principal supporter of this view was Gay-Lussac, who wrote in 1819. It has since been shown to be utterly untenable.